

## RTRI Develops a Device to Prevent Bridge Collapse

RTRI Developed an effective seismic retrofit measure for steel bridges in a narrow space, a device to prevent collapses of bridges with vibration control mechanism (Fig.1). This device prevents collapses of bridges in a large earthquake and reduces displacement of the bridge beam. This device can be mounted to locations where there is only narrow space under the bridge or around the bridge column.

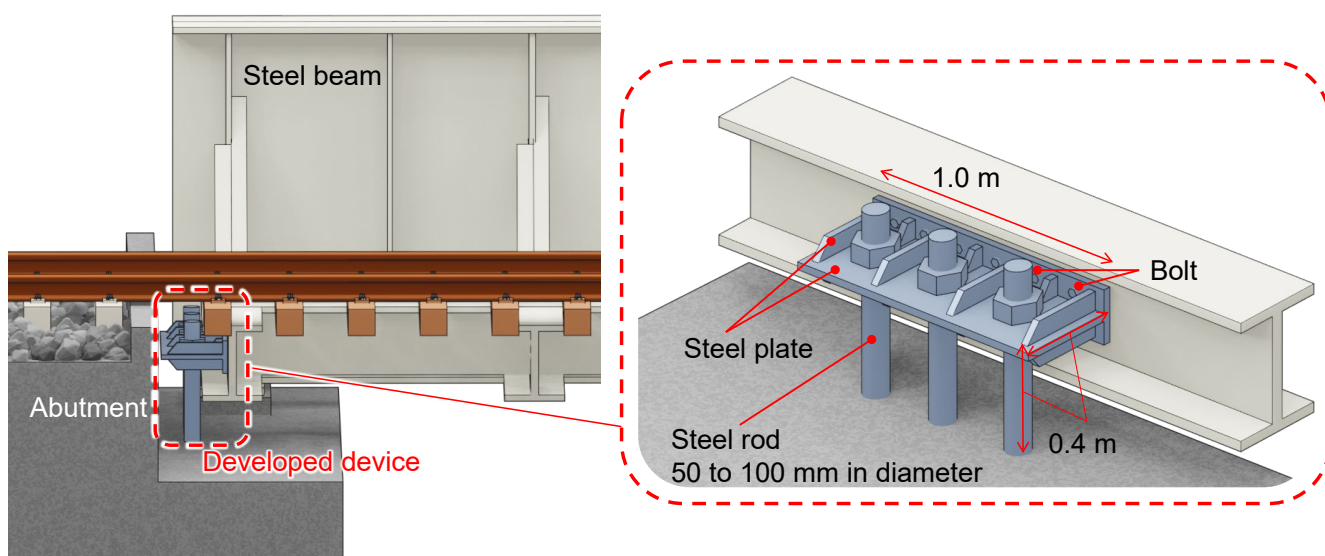


Fig. 1 Device to prevent bridge collapse with vibration control mechanism

### 1. Background

In the 2016 earthquake in Kumamoto, a road bridge collapsed. The steel columns of this bridge had the pinned support structure which has rotatable ends. A lot of railway bridges with similar structure (Fig. 2) were constructed in urban areas from 1890's to 1950's and improvement of seismic performance of them is necessary. However, if the old bridge has only limited space under the beam as is shown in Fig.2 (Restraint 1), existing seismic countermeasures are not available. If the space around the beam support is limited as in Fig. 2 (Restraint 2), it is also difficult to apply any of the measures. Due to these restraints, it has been required to develop a device which can be mounted to bridges in narrow place, does not protrude into under-bridge space and prevents both displacement of beams and collapse of the bridge.

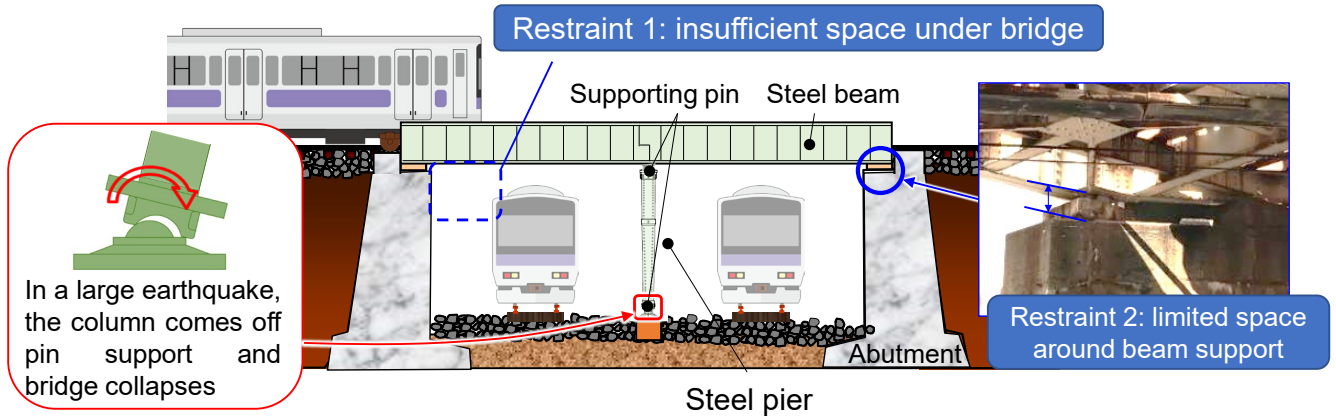


Fig. 2 A railway bridge supported by steel columns

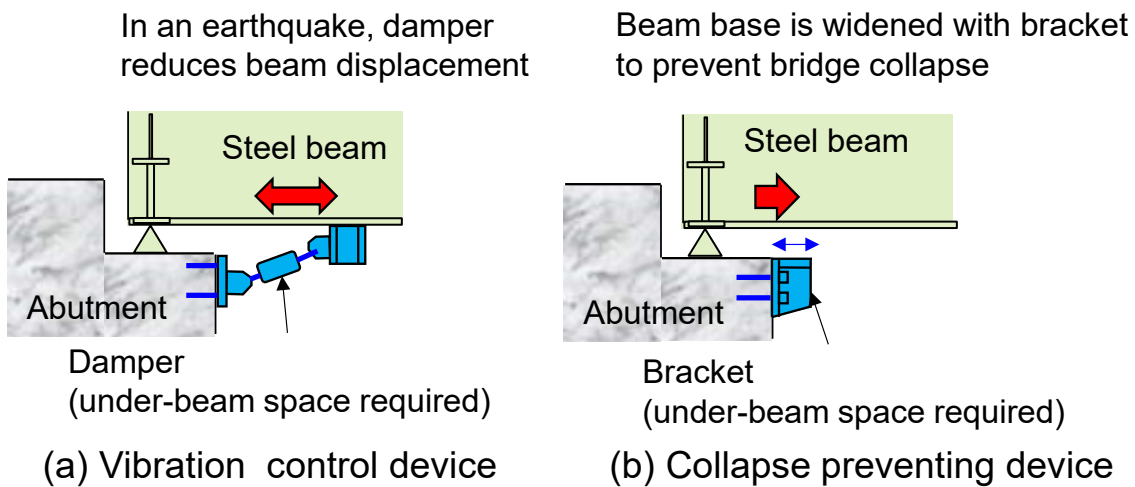


Fig. 3 Existing seismic countermeasures

2. Outline of the developed device

A device to prevent bridge collapses, made by combining steel plates and rods. It is easy to build and has the vibration controlling function as well.

- Steel rods with diameters of 50 to 100 mm are connected together by steel plate and bolted to the bridge beam (Fig. 1).
- As its dimensions are 1.0 m long in the direction perpendicular to rail, 0.4 m in the rail direction and 0.4 m high, it can be mounted to the beam support with narrow space (Fig. 1).
- When an earthquake occurs, the rods absorb vibration energy by plastic bending deformation control vibrations and reduce displacement of the beam (Fig. 4 (a)).

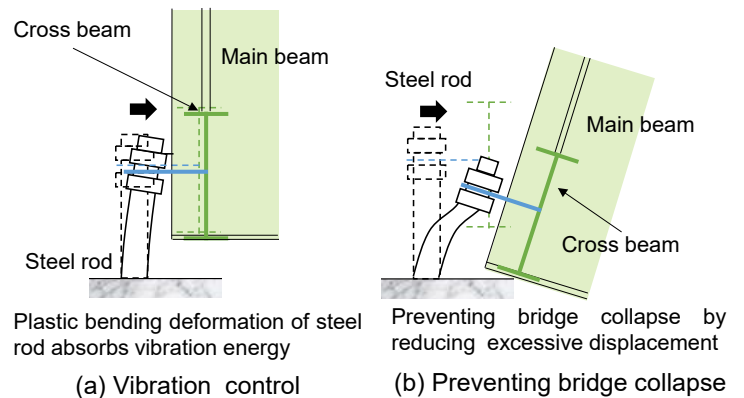
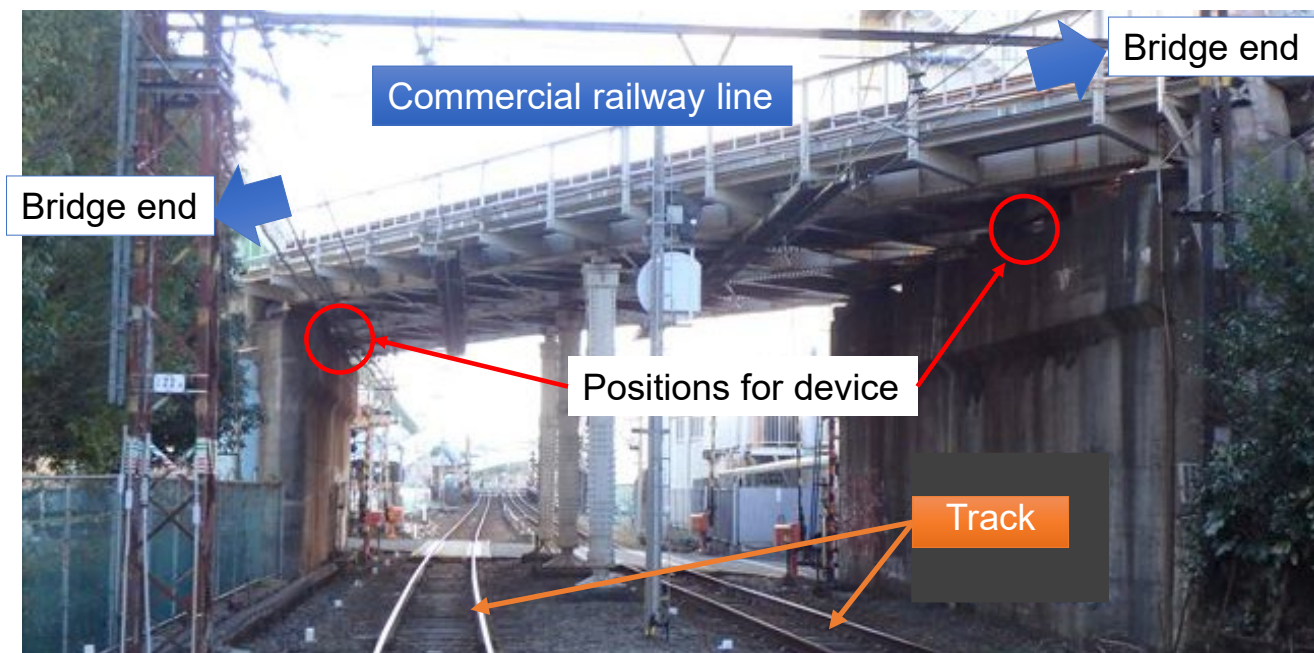


Fig. 4 Functions of the device

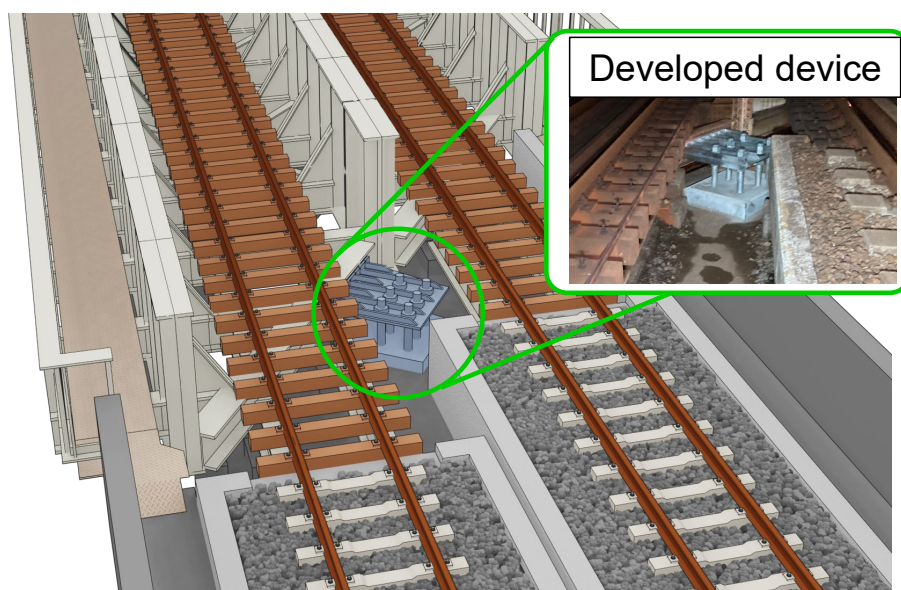
- In case that the beam is excessively displaced, the device supports the weight of the beam and prevents collapse (Fig. 4 (b)).

### 3. A bridge on a commercial railway line reinforced with this device

This device was mounted to a bridge on a line of the West Japan Railway Company for the first time on December 20, 2022. The device was chosen to reinforce the steel bridge constructed in 1928 because another railway track is crossing under the bridge and there is not work space necessary for existing measures (Fig. 5).



(a) The position that the device is mounted



(b) The bridge mounted with the device

Fig. 5 The device mounted to a bridge on a commercial line